HINTS ON SPECTACLES.

When Required and How to Select them.

BY

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THE Author of these hints may be consulted on all matters relating to Spectacles, daily from Ten till Four, Saturdays Ten to Twelve, or any other hour by appointment, at the establishment of Messrs. HORNE and THORNTHWAITE, Opticians to Her Majesty, 122 and 123, Newgate Street, London.

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HINTS ON SPECTACLES.

By W. ACKLAND, L.S.A.

It has been truly remarked, that of all the boons conferred on mankind by science, none excel, and few equal, that of correcting, by optical means, the defects and irregularities of sight, whether such arise from alteration in structure or malformation of that wonderful and delicate organ, the eye.

As sight is to each of us so important, any means by which we can assist to preserve it, must be hailed with satisfaction, and a few minutes, spent in perusing the following hints, may not be unprofitably employed, indeed, may even be the means of directing the reader's attention to a proper consideration of this subject.

The Structure of the Eye.—The eye is the organ of vision, by which light, reflected or emitted from external objects, is concentrated on a delicate tissue of nerves called the retina, and excites in us a sensation which reveals their presence, and from which we acquire the greater portion of our knowledge of the material universe.

The eye, of which a section is given in Fig. 1, is, in form, nearly spherical, the exterior part being slightly more convex than the remainder. It is composed of

four coats or membranes—the sclerotic coat, *a a;* the cornea, *b;* the choroid coat, and the retina, *r r.* These coats enclose three humours, the aqueous, *d;* the vitreous, *v;* and the crystalline humours, *l.*

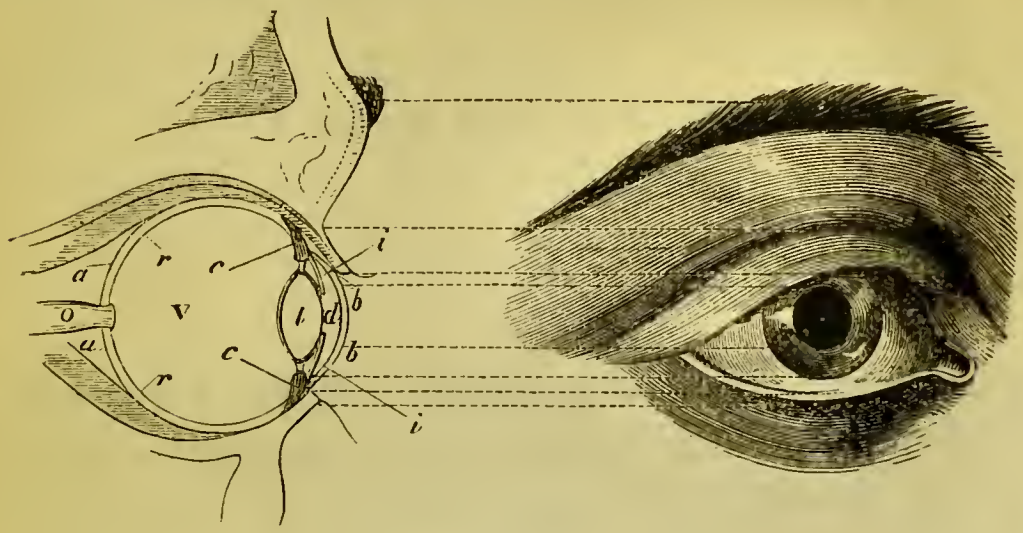


Fig. 1.

The sclerotic coat, *a a*, commonly termed the white of the eye, is a strong and tough outermost coating, covering nearly four-fifths of the entire globe of the eye, and to this are attached all the muscles which give motion to the eye ball. The sclerotic coating is thickest at the posterior part, and gradually thins off, until it joins the more anterior and transparent coating, termed the cornea.

The cornea is represented by *b b;* and is the first optical surface at which rays of light, entering the eye, are refracted; it is exceedingly tough, and equally thick in all its parts, being composed of several firmly adhering layers, capable of offering great resistance to external injury. The external surface is convex, and the internal concave.

The sclerotic coat is lined with a soft cellular structure, termed the choroid, whose inner surface is covered with a black pigment, the use of which is to absorb and

stifle all the light entering the eye, as soon as it has done its duty in exciting the retina, and thus prevent internal reflection, and consequent confusion of vision; exactly in the same manner as we prevent internal reflection in telescopes, by blackening the inside of the tubes.

The optic nerve enters the eye at *o*, and immediately spreads itself over the black pigment in the choroid as a most delicate reticulated expansion, and is here termed the retina, *r r*.

The retina and optic nerve of the healthy eye are capable of receiving and transmitting to the brain the impression of external objects.

The iris, *i i*, is an annular opaque diaphragm, placed between the cornea and crystalline lens, and divides the eye into two unequal parts, *d* and *v*. The iris constitutes the coloured part of the eye, and is perforated by an aperture termed the pupil, which is circular in man, and elongated into a slit in some animals. The function of the iris is to regulate the quantity of light admitted, and is found to contract when looking at a bright object, and to expand if light is less abundant. It, moreover, serves to prevent aberration, as it stops all rays that would otherwise fall on and pass through the edge of the crystalline lens.

The chamber anterior to the iris, *d*, contains a transparent fluid, like water, termed the aqueous humour, whilst the posterior chamber, *v*, contains a rather more viscid liquid, termed the vitreous humour.

The crystalline lens, *l*, is a much more solid body than either the aqueous or vitreous humours, remarkable for its transparency, and is made up of a series of concentric layers, which are hardest at the centre.

The crystalline lens is more convex behind than in front, and is suspended in a transparent capsule by the ciliary processes, *c c*, which are firmly attached to every part of the margin of the capsule.

FIG. 2.

Theory of Vision.—The above rough outline of the anatomy of the eye will enable us somewhat more readily to understand the action of rays of light on this delicate organ, and we at once perceive that it may not unaptly be compared to a camera obscura, of which the pupil is the "stop" or contracted aperture, the crystalline lens is the object glass, and the retina the focussing screen. Hence the effect is similar to that when an object is placed in front of the camera, as an image is formed at the focus of the lens on the focussing glass. If we imagine rays of light emanating from any distant object, as in *o*, FIG. 2, they proceed in a straight line, and on entering the cornea and aqueous humours experience a first refraction, or are brought nearer the axis. They then traverse the crystalline lens, and are by its action bent still nearer the central line, and then entering the vitreous humours, are finally refracted until they meet and unite to form an image of the object on the retina, by which the impression is conveyed to the brain, and what we call vision is produced.

Adjustment of the Eye.—The above is the nature of vision for parallel rays, or those rays emanating for distant objects, but we are also enabled to see distinctly objects close at hand; and as the focus is longer for near objects than for those more distant, it is evident that the eye must possess a voluntary power by which its convergence can be increased, which power is called the adjustment of the eye.

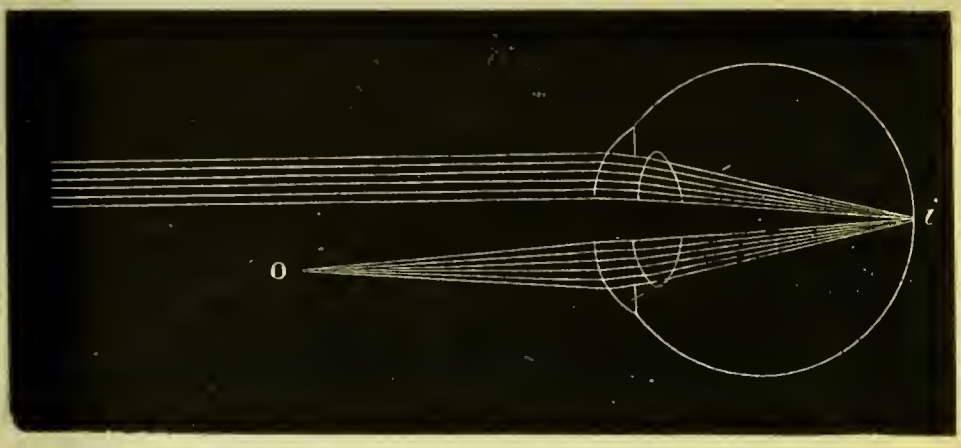


Fig 3.

This may be dependant on the space between the retina and cornea being increased, and the eye lengthened in the direction of its axis, or the curvature of the crystalline lens increased. Assuming the latter as the most probable, the upper half of Fig. 3 represents the section of the eye and convexity of the crystalline lens when viewing distant objects, whilst the lower half shows the increase of convexity that is necessary for the crystalline to possess in order to view an object situate at *o*.

Anatomists, philosophers, and opticians differ as to the means employed by nature to effect such an important object; and although this question has been warmly discussed, each advocating their own pet theory, we are as yet far from the discovery of the cause, and must content ourselves with a knowledge of the result

We clearly know it exists, we appreciate its advantages; but whilst we may boast of tracing so far the refined contrivances of this admirable organ, we need be under no false shame in pointing out something that eludes our scrutiny.

One set of philosophers assert that the power is produced by the simultaneous contraction of all the straight muscles of the eye, producing pressure on the orbit, compressing the fluids within, and causing its elongation.

Another opinion is, that when we wish to examine near objects, the crystalline lens is increased in curvature, and certainly the structure of that lens, and the surrounding ciliary process, lead me to lean to this mode of explanation.

It matters little whether we lean to the one or the other theory, so that in practice we give due weight to this power, when we come to speak of supplying the deficiency of vision by spectacles.

Long Sight.—We have already stated that the healthy eye can distinguish near and distant objects with equal facility. By this we mean any object not nearer to the eye than eight inches; but at a certain period of life *long-sightedness* occurs, which shows itself by a difficulty of distinguishing any object closer to the eye than fourteen, sixteen, or eighteen inches, although objects at a distance are as easily seen as in youth.

When this occurs, the rays of light from a near object, *o*, after being refracted by the eye, fail to form a sharp image, on the retina, but behind it at *i*, as on FIG. 4; hence, instead of accurate vision, imperfect haze is the result, and clearness can only be obtained by removing the

object to a greater distance, or increasing the light, so as to cause an undue contraction of the pupil.

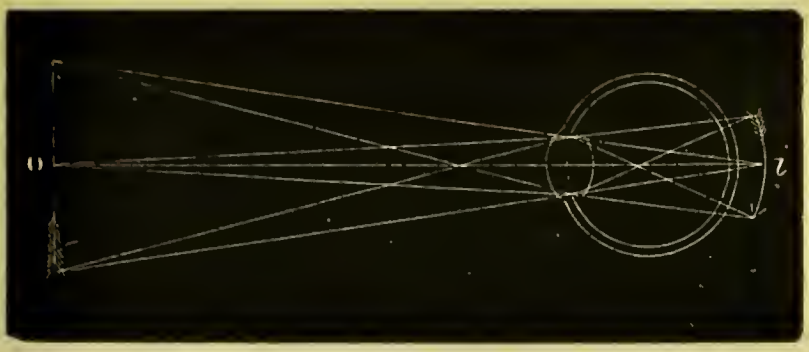


Fig. 4.

Short Sight.—In short sight, distant objects cannot be distinctly seen, and even near ones must be brought very close to the eye to see them distinctly. This arises from too great a convexity of the crystalline lens and cornea, and is in many cases congenital. Fig. 5 shews

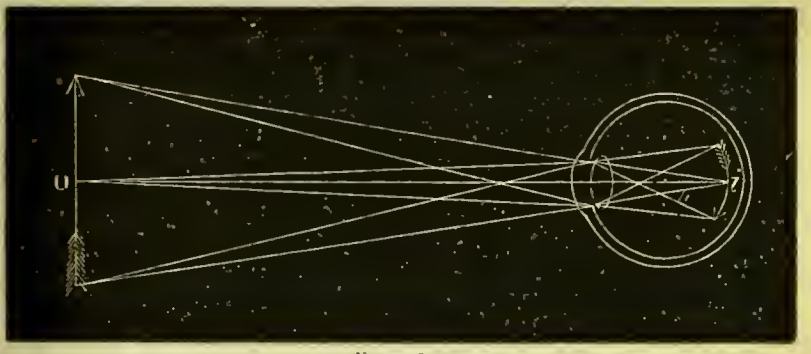


Fig. 5.

the rays from a distant object, *o*, after passing through the eye, converging to a point *i*, before they reach the retina.

Hypermetropia or Oversight.—This is the very reverse of short sight, and is dependant on a defective formation of the globe of the eye, so that *converging* rays form a distinct image on the retina. In the naturally formed eye, distant objects are seen without exercising any portion of its adjustment, and for near objects this power is called into play to a moderate extent, whereas the Hypermetropic eye requires to exercise a considerable portion of its adjustment for seeing

distant objects, whilst an excessive strain is needed to see those near at hand. The result is, that after a short time the eye tires, lassitude extends to the brow, vision becomes hazy, and a cessation of the occupation that requires such a strain is needed, and repose for a longer or shorter time must follow before the eye can be again used, only to be as speedily disabled again and again.

This affection is much more common than is usually believed by medical men, and is often treated as weak or abnormal sight. Should a cursory trial of spectacles be made, they are likely to be pronounced as affording no assistance; for the eye, being so accustomed to use its adjustment *in excess*, fails to appreciate the advantage of having less work to do; but if the use of a pair of spectacles of suitable foci be persevered in for some five minutes or so, the eye ceases to strain itself, and the optical assistance offered is then fully appreciated. Unfortunately, there are a great many sufferers from this malformation who imagine that no assistance could be rendered them by spectacles, from having, perhaps, tried a dozen different pairs for a few seconds each; and I have even known instances of celebrated oculists who failed to detect this condition of the eye, although to the careful observer it was most apparent. Watchmakers, needlewomen, and engravers are often found to suffer much from this peculiar state of vision; it is also frequent even amongst children, and may be considered hereditary. Parents therefore, having children with weak and imperfect vision, should in all cases have their eyes tested, in order that proper means may be adopted to render all the assistance science can afford.

The usual mode of examining the eye by "test type"

often fails to detect this malformation ; but in my new form of optometer we have the most ready means of doing so, for whenever the "far" point of vision exceeds 10, we may suspect its presence, more especially if the eye is small and sunken, with indications of a short globe and flattened dull cornea ; and if the optometer indication exceeds 12, we may prognosticate Hypermetropia to be present to a certainty.

Hypermetropia often causes convergent squinting, and a person so afflicted is frequently unable to read unless the book is held closer than usual to the eye, and is then considered to be short-sighted, and furnished with concave glasses, which he is unable to use for any time, and they are after a few attempts laid aside as useless ; but unfortunately these failures create an idea that optical means cannot afford any assistance in his case, and the eyes become weaker and weaker until vision is so impaired as to be nearly useless.

Atropine is usually employed by medical men to detect this state of vision ; and in order to explain the uses of the optometer in Hypermetropia, and the uselessness of atropine, I may cite the case of a patient in St. Bartholomew's Hospital, whose eyes I was called on to examine. This patient had been operated on for convergent squinting, but with only partial success. Cursory examination showed the peculiar conformation of the eyes, denoting Hypermetropia, and the optometer indications were 5.6 for the near point, 23. for the far point. 48in. convex lenses improved the vision for both distant and near objects. Two hours after the introduction of a drop of a solution of atropine (4grs. to the oz.) into each eye, the optometer indications were, for the

near point 38., and for the far point 42., and the eye had from the action of the atropine temporarily lost the power of discerning either near or distant objects distinctly, but could read ordinary print easily at 12 inches with 7-inch convex lenses, and see distant objects with convex lenses of 16in. focus. Viewing the atropine first as acting on the near adjustment of the eye, so as for a time to suspend its action, and secondly as contracting the muscular fibres of the ciliary process so as to increase the far point, we discover of how little value such a commonly used remedy is to give any available information ; indeed we have seen an abnormal extension of the far point that would call for an increase of focal power in the lenses employed. Taking, therefore, the optometer indication before the use of atropine as reliable, I gave a pair of 10-inch convex spectacles, in using which, for reading, the patient had to call into play only a power of adjustment equal to about one-half of that possessed by a healthy normal eye, and the result was a cessation of the unpleasant strain, and improved vision. I am led, from the consideration of the above and numerous other cases, to condemn the use of atropine to detect latent Hypermetropia, as every necessary indication needed for such a purpose can be obtained by using my optometer, and its accompanying tables.

This fact is highly important, when the applicants have to earn their daily bread by the exercise of their vision, as the eye takes at least three or four days to recover from the paralysing effect of this remedy, and for that time ceases to be available to discern any near object, and the poor applicants so treated have often to be dependant on others for support during its action.

In those cases where the eye is weakened, the optometer indications above 12, and the adjustment impaired—two pairs of spectacles are needed, one for reading, &c., and the other for viewing distant objects: for it must be borne in mind, *that every act of seeing is a strain to the weakened eye,* and we must relieve it of such overwork, in order to allow it to regain its usual activity.

Weak Sight.—There are many causes acting to produce a weak state of vision, the most common being that of a Hypermetropic condition of the eye, which, as above stated, is promptly relieved by suitable spectacles; but there are others in which no Hypermetropia exists, in which reading soon becomes painful, the words are confused and appear mixed up together, whilst the eyes become red and watery, are fatigued, and often headache ensues. If the eyes are closed, and allowed to remain so for a time, the reading may be resumed; but the symptoms soon return with increased pain, whilst the objects viewed are more misty than before. This is often caused by a defective action of the internal recti muscles, allowing the eyes to converge too much, instead of being properly directed to the objects viewed—hence a double and confused image is formed on the retina, instead of being single and sharply defined.

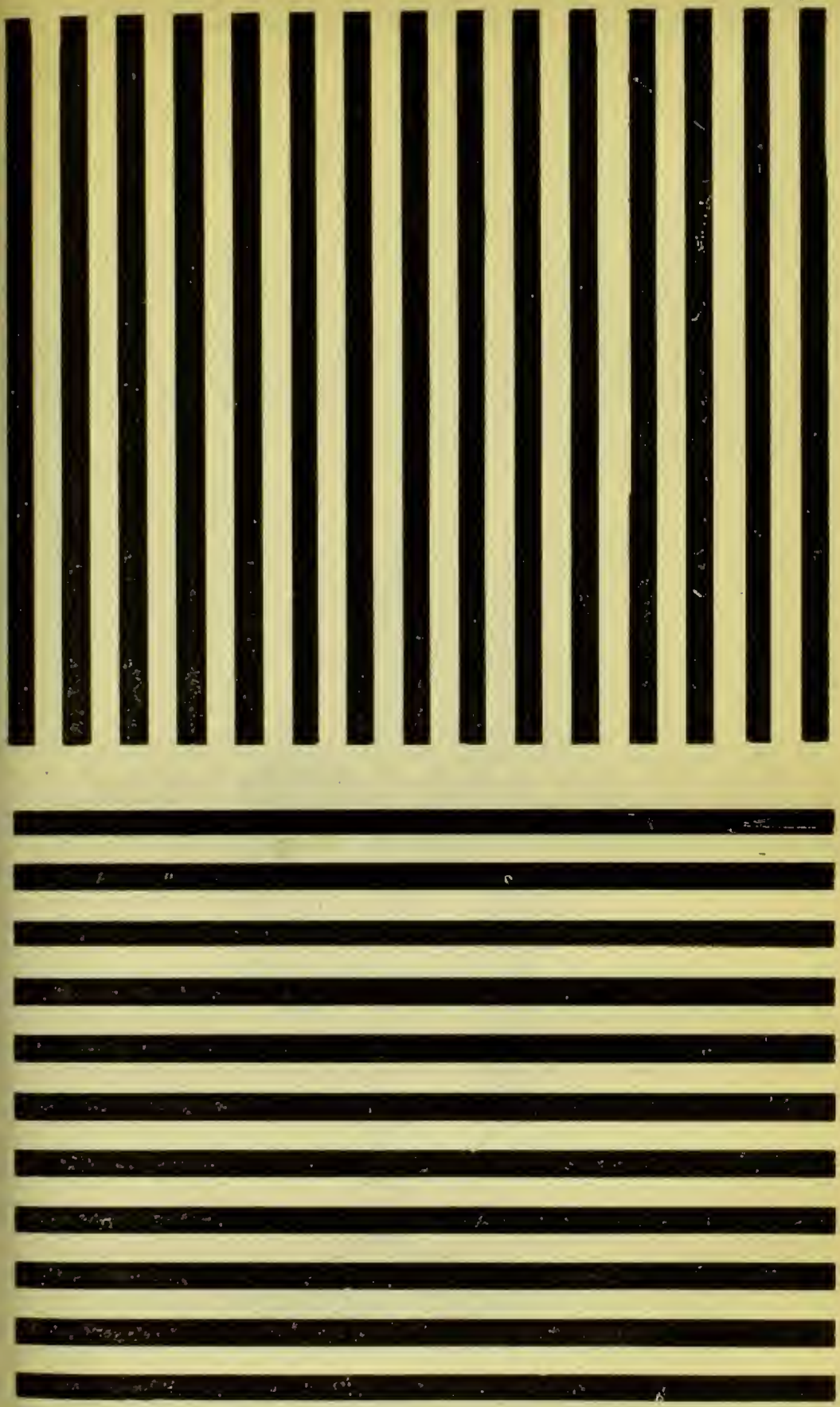
These symptoms are promptly relieved by the use of prismatic lenses, which often restore a proper degree of action to the muscles at fault; but their use requires caution, and they must be changed from strong to weak, as occasion requires.

Another form of weak sight arises from the two eyes having different foci, as in such a case the two retinal images being of different sizes cannot be united to give

the impression to the brain of a single sharply defined object, and a certain state of imperfect double vision is the result. This state of the eyes having different foci is frequently met with, and where the differences are considerable, lenses adapted to each eye must be used—and it frequently happens that with suitable lenses of different foci, both eyes can be called fully into action; and an alteration, tending to equalize these foci, being made from time to time, we can at last bring both eyes to the same focus, and of course to yield the same size retinal image.

Astigmatism.—This is frequently the cause of weak and imperfect vision, and is caused by either the cornea or crystalline lens differing in curvature in its different meridians; the vertical meridian is generally shorter than the horizontal. If an astigmatic eye views the horizontal and vertical lines on the opposite page, it will be found that the vertical lines can be seen distinctly at a greater or less distance than the horizontal ones; which proves that the vertical meridian of the eyes differs in focal power from the horizontal—of course, it must be perfectly understood that different eyes differ in different meridians, therefore the lines should be arranged in various directions when tested, and the variations noted.

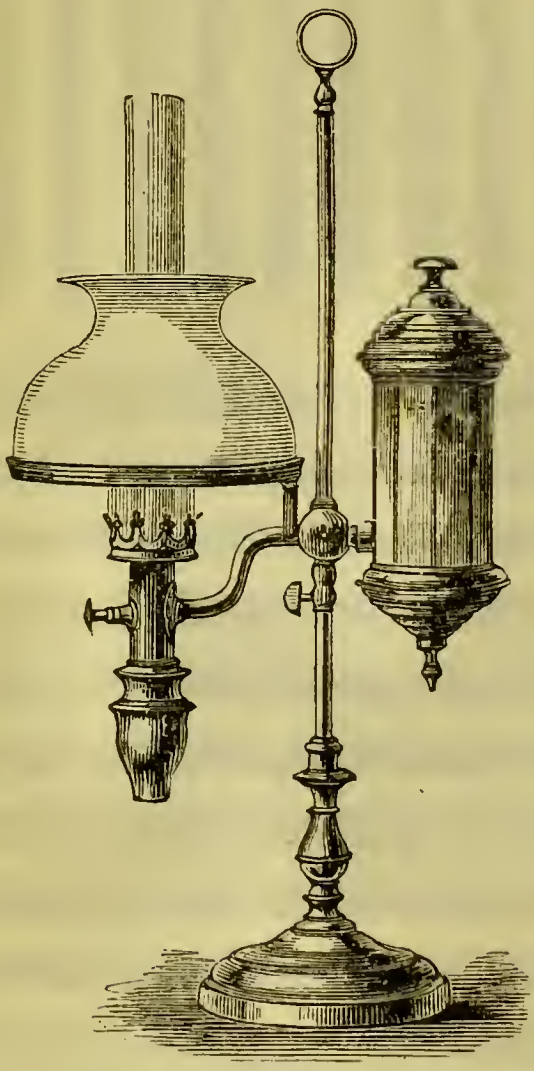
Another mode of testing for the presence of Astigmatism is to look at a watch face (using spectacles, if needed) held at a distance of 10 inches, when if the XII. and VI., the IX and III are not equally distinct, the presence of Astigmatism is indicated. To remedy this defect, cylindrical lenses are employed, and with a greater or lesser amount of success, in proportion as this defect is more or less free from other malformations.



Set of horizontal and vertical lines for determining the presence or absence of Astigmatism (see page 14.)

Paralysis of the Eye's Adjustment.— This complaint is often a cause of weakness of vision, resulting from debility of the general system, after fevers, diphtheria, &c., &c., or from other causes tending to weaken the nervous system.

The remedy here is to improve the general health, and give tone to the system; but the employment of spectacles must be left to be decided by each individual case, as sometimes they are beneficial, whilst in other cases useless, and even injurious.



HORNE AND THORNTHWAITE'S READING LAMP.

Reading Lamps.—Those suffering from weak or

impaired vision should be very careful to employ only the very steadiest flames for reading, sewing, &c., and never use the flickering, glaring light of gas,—nor should they at any time allow the light to fall on the eyes, but only on the book or object viewed; using a properly constructed shade to accomplish this purpose. The Reading Lamps advertised on the cover of these hints, and figured above, give a soft mellow and subdued light, exceedingly pleasant to the weakened vision, and affording such an amount of comfort as to merit the title of a boon to the afflicted.

On the Symptoms Indicating a Necessity for Spectacles.—The natural decay of vision occurs usually from thirty to fifty years of age, varying according to habits and employment of the individual. Sometime during this interval the refractive power of the crystalline humours of the eye slightly alters its condition, whilst the crystalline lens and cornea change their form, so that a difficulty of distinct vision is felt. The eye loses a portion of its power of seeing at varying distances, or its power of adjustment; and near objects are no longer as easily seen as in youth. Reading small print by candle light is difficult, as the book requires to be held at a greater distance from the eye than formerly, and a more powerful light is needed, and even then the letters appear misty, and to run one into the other, or seem double. And still further, in order to see more easily, the light is often placed between the book and the eye, and fatigue is soon felt, even with moderate reading.

When these symptoms shew the eye to have altered its primitive form, spectacles are absolutely needed. Nature is calling for aid and must have assistance, and

such is longer withheld, the eye is needlessly taxed, and the change, which at first was slight, proceeds more rapidly, until a permanent injury is produced.

There is a common notion that the use of spectacles should be put off as long as possible, but such is a great mistake, leading often to impaired vision for life, and is even more injurious than a too early employment.

Timely assistance relieves the eye, and diminishes the tendency to flattening, whereas should the use of spectacles be longer postponed, the eye changes rapidly, and when the optician is at last consulted, it is found that a deeper focus spectacle must be used than usual for the first pair, and even these suit but a short time, and have to be again exchanged for those of still deeper power; and these frequent changes become a matter of necessity which, unless judiciously checked, continue during life.

It must not be forgotten that, when first using spectacles, they are not required during daylight, but only for reading, &c., by artificial light, and it may be from six months to two years from the time of first adopting them ere they will be required for day use.

Spectacles for the Shortsighted.—Short sight is often present at birth, but is little noticed, nor its inconveniences felt, until study becomes imperative. When this occurs, the power employed should be always slightly under that needed to remedy the defect, otherwise the eye will gradually accommodate itself to the lenses, and require constantly an increase of power. In all cases leave some little for the adjustment of the eye to do, and then you may, after a time, diminish the power of the lenses needed.

The Optician's Knowledge.—Having now shewn

when spectacles should be employed, let us for a moment consider what are the requirements that should in all cases be possessed by the optician to whom the selection of spectacle lenses is entrusted.

These requirements are :—

1st. An intimate knowledge of the anatomical structure of the eye, and of the theory of vision.

2nd. An extensive acquaintance with the science of optics.

3rd. A sound mathematical knowledge.

4th. A practical acquaintance with the manufacture of lenses and spectacle frames.

Having for the last fourteen years made the adaptation of spectacles my especial study at the establishment of Messrs. HORNE and THORNTHWAITE, Opticians to the Queen, 122 and 123, Newgate Street, I have frequently met with cases where great injury has been done to the weak-sighted, by the ordinary optician's improper selection of spectacles ; and I could heartily wish more of my medical brethren would bring their medical knowledge to bear on this subject,—which demands and frequently calls forth all the science and skill we possess, to meet the requirements of some abnormal cases that present themselves.

Spectacles and other Optical Adjuncts to Vision.—It is to the abnormal conditions of the eye that the optician has mostly to direct his attention and to ascertain how far he is enabled to ameliorate or remove them by optical means, and it is therefore proposed in this chapter to give a description of spectacles for long, short, and weak sight, eyeglasses and folders.

Spectacles are so well known, that any description of their general form is quite superfluous. They are constructed of either gold, steel, silver, German silver, or tortoiseshell, and it is curious how fashion alters even the material of this useful article. Our grandfathers' spectacles were mostly made of silver or horn, whereas these materials are now seldom used. Steel, for its lightness and durability, and gold for its appearance, are mostly employed, and I may here remark, *that I hold it as essential that the spectacle frame used should fit the face as that the lenses should suit the eye.* Who is there that, having once worn properly-fitting spectacles, would ever wear a pair picked up at random. My opinion on this point is fully confirmed by daily observations; any observant person may easily satisfy himself that few opticians pay any attention to that point, by noticing the fit of the spectacles of those with whom he is brought in daily contact (more especially in a country town).

A few points only need be attended to, in order to arrive at a conclusion on this point, such as noting the fit of the bridge on the nose, whether the pupils are opposite the centres of the lenses, and whether the frame fits without pressure on the temples and cheeks. Spectacles, as made for the trade, are usually constructed too much after a few models, so that the optician, even if he desires it, cannot supply from his stock a suitable frame. Take, as an example, two cases that occurred on the same day: one was that of a lady, extremely narrow between the pupils, and wide at the temples; the other was exactly the same width between the temples, but the pupils were very much wider apart. FIG. 6 repre-

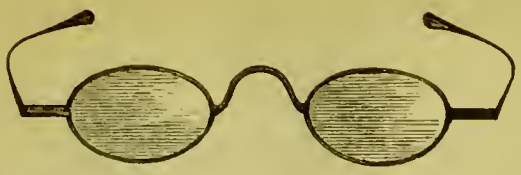


FIG 6.

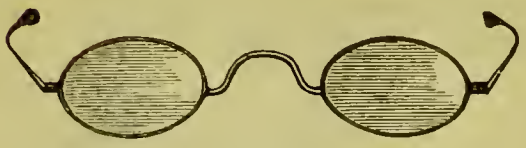


FIG. 7

sents the spectacles for the first, and FIG. 7 that for the second, and both pair had to be made to order; indeed, with a stock of spectacles perhaps as extensive as any English firm, it is often impossible to find a pair that EXACTLY suit in every particular. Hence I have lately adopted the plan (where a few days is no consideration) of making all spectacles to order, *from actual measurements of the face*, and thus securing a perfect fit; and the post serves as a secure mode of conveyance, where parties pay me a visit during their stay in London, but reside at a distance. Another advantage of this plan is, that as a register of every essential particular of the pair of spectacles supplied is made, in case of loss or accident, another pair, exactly similar, can at any time be obtained by post, by forwarding the cost by post-office order.

Spectacles are often made with simple branches or sides, like FIG. 6; but when they are required to be worn during active exercise, double sides, like FIG. 13, prove advantageous, whilst extremely light frames, such as are sometimes used for walking or riding by the

short-sighted, require the sides to be single, but curved, like FIG. 8.

FIG. 8.

The shape of the nose is very varied, indeed as varied as the shape of the face itself; and where comfort is considered, the bridge of the spectacles should fit over and rest lightly on the nose.

When spectacles are used by the long-sighted, they are of use only in enabling the wearer to see near objects, as distant ones can be more easily viewed without any such aid.

Too much stress cannot be laid upon the advice, that *the long-sighted should never look through their glasses at distant objects*, as such a practice, if persevered in, even for a short time, causes the eye to lose its power of adjustment, and ere long two pairs of spectacles will have to be in constant use, one for near, and the other for distant objects..

When spectacles of the ordinary form are used, the wearer is compelled either to look through, or remove them every time a distant object has to be regarded. This arises from the lenses being so arranged as to be directly in front of the eye.

To obviate this serious objection, Messrs. HORNE and THORNTHWAITE introduced the Pantoscopic form of spectacles, shown in FIG. 9, by which it may be

Fig. 9.

noticed that one great peculiarity of this form of spectacle is, that the lenses are not the usual oval form, but flattened at the top, nor are they placed directly in front of the eye, but obliquely to it. Before adopting them, they submitted them to Dr. Alfred Smee, F.R.S., Surgeon to the Central London Ophthalmic Hospital; whose report was highly satisfactory, and clearly showed that the pantoscopic form of spectacle frame should, in all cases of long sight, be used, so that the wearer may have the lenses in the best possible position for reading, and seeing near objects, whilst this peculiar construction enables distant ones to be seen by looking over the frames. The form of lenses employed in this kind of spectacles, we shall speak of hereafter.

Scientific men are fully agreed, that in order to see most distinctly through a lens, we must so place it that its *centre* is opposite the pupil of the eye; hence, in fitting a pair of spectacles, it behoves us to be extremely careful in so selecting the frame, that the distance between the centres of the lenses is $\frac{1}{20}$ of an inch less than the distance between the pupils of the wearer. This slight difference being made, in order that the rays of light proceeding from a near object (which are divergent) may pass through the centre of the lenses to the eye.

For the same reason, spectacles for short sight, if for reading, should be so made that the centres of the lenses are *a trifle* less apart than the pupils; but if for viewing distant objects, the distance between the centres and pupils should agree.

What is technically termed HAND FOLDERS, FIGS. 10, 11, and 12, are exceedingly handy for occasional use,

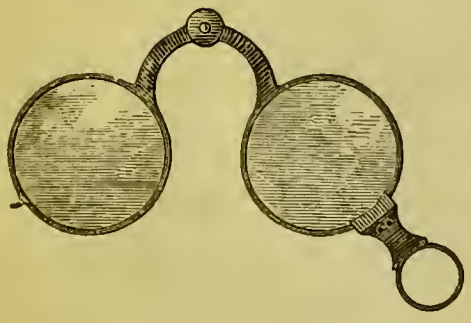


FIG. 10.

FIG. 11.

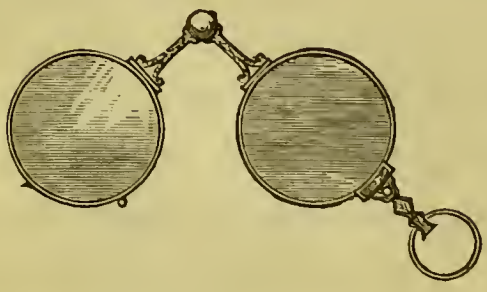


FIG 12.

such as the examination of a small foot note, or reference to an address or note, when walking, but their constant

use for reading, &c., tends to strain and irritate the eyes, and thus produce rapid changes of that organ. This arises from the lenses being seldom held parallel to the eyes, and also from the vision being effected through their outer edges, and not through the centres. Those, therefore, who value their sight should use spectacles for reading, writing, &c., and not overtax or strain it by the employment of unsuitable assistance.

Of single eye glasses, little can be said but in the way of condemnation, as their employment causes the focal distance of one eye to differ from the other, and often lays the foundation of most serious mischief.

Where spectacles are employed to diminish the amount of light admitted to the eye, the frames may be either the usual shape; or where more absolute freedom from side glare is necessary, they may, with advantage, have what is termed glazed wings, like FIG. 13.

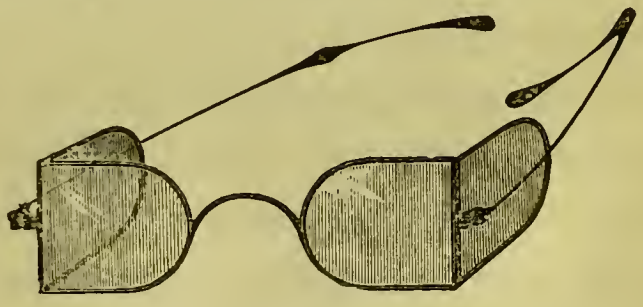


FIG. 13.

This latter form is the most useful to prevent solar radiation and reflection, in alpine and Indian travelling.

The colour of the glass to be used in spectacles of this kind, is one to which I have given some attention, and I have arrived at the conclusion, that the *largest* amount of distinct vision, together with the *least* amount of glare, is obtained by using a kind of glass which may be termed a neutral blue; and to confirm the good opinion I have formed of this peculiar colour, I am enabled to

state, that it is recommended as the most suitable to be employed by those whose eyes are irritable, or vision weak, by that celebrated oculist, Dr. Lawrance, of Connaught Square, and many others.

Spectacle Lenses.—The materials employed in the construction of spectacle lenses, are glass and Brazilian pebbles. If glass is selected, it must be transparent and colourless, sufficiently hard to bear a good polish, and not liable to lose that polish by damp or exposure. All these good qualities are possessed by crown glass, specially made for the purpose; whereas the ordinary plate glass often used, where cheapness is a consideration, fails to possess many essential qualities, and is, consequently, condemned by the conscientious optician. The main objection to glass of any kind for this purpose is, that it is so easily scratched.

Deep scratches or indentations are not here referred to, but to the innumerable fine scratches, scarcely visible except under the microscope, which are produced, more or less, each time of wiping. After a few months, such a lens becomes unfit for use, straining the sight, and paining the wearer, although, to the naked eye, the polish appears as perfect as when new.

To remove this serious objection, lenses are employed made from rock crystal, and commonly termed pebbles, and this material, being in hardness only exceeded by that of the diamond, is not liable to be scratched in use, and, moreover, it takes a higher polish, hence the strain to the eye is reduced to a minimum, and one cause of irritation removed.

Rock crystal is mostly imported from the Brazils, and is found native in both masses and crystals. The latter

are in shape like FIG. 14, and when required for spectacles, are cut into slices of the requisite thickness by diamond powder, no other material being found to answer this purpose.

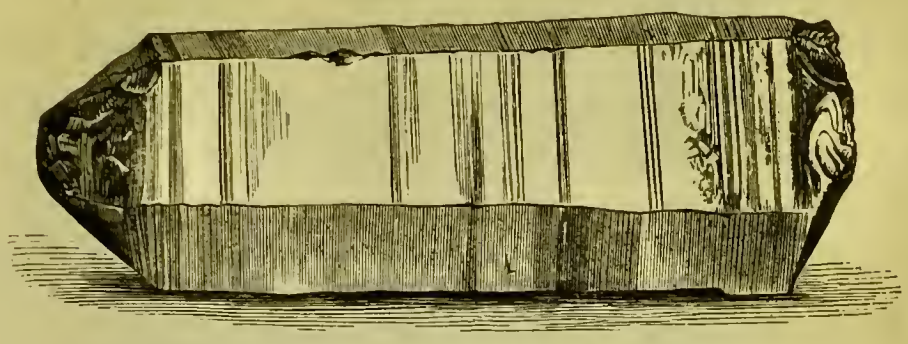


FIG. 14.

Unfortunately, even in this article, "cheapness, without consideration of quality," acts prejudicially; for the direction in which the section of the crystal is cut affects the quality of the resulting lens. One direction yields us a clear transparent section, which admits the passage of every description of light, without undue refraction or interference, whereas a section in an opposite direction shews colour under polarized, and sometimes even under ordinary light, and from its interference is totally unfitted for spectacle lenses.

We often see advertisements of cheap pebble spectacles, but they prove dear ones to the unfortunate purchaser, for the crystal from which the lenses are made is cut at random in every direction that will yield the greatest number of slices, hence they often produce lenses worse than useless, and do irreparable mischief to the wearer.

Not long since, a gentleman applied to me, complaining that, after using a pair of pebble spectacles, purchased of a respectable firm, he invariably found one eye irri-

tated and weakened, and wished me to explain the cause.

Examination of the lenses by polarized light, showed one of the two to be properly cut from the crystal, and that the other (the one complained of), was cut in a wrong direction. A removal of the defective lens, and the substitution of another, properly cut, and of the same focus, cured the evil.

Presuming that we have decided in favour of rock crystal as the substance from which our lenses are to be made, it still remains to determine what form we shall give these lenses. Opticians have terms to designate the various curvatures of lenses; those mostly employed are the double convex, FIG. 15, where the curves are equal.

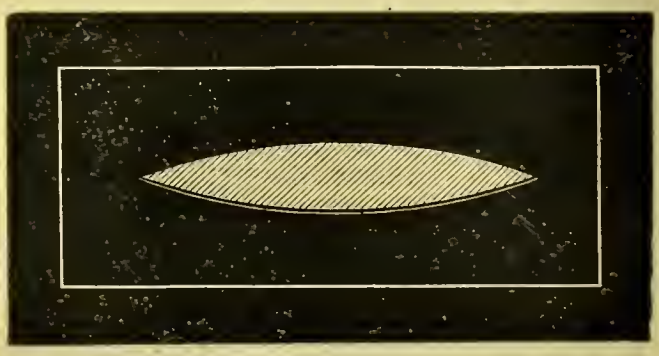


FIG. 15.

The crossed lens, FIG. 16, where the curves are unequal.

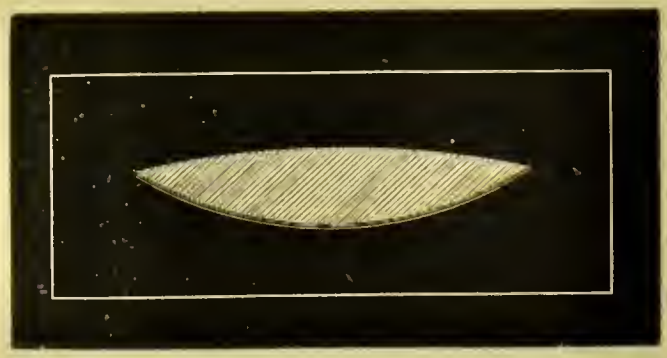


FIG. 16.

The double concave, FIG. 17 ;

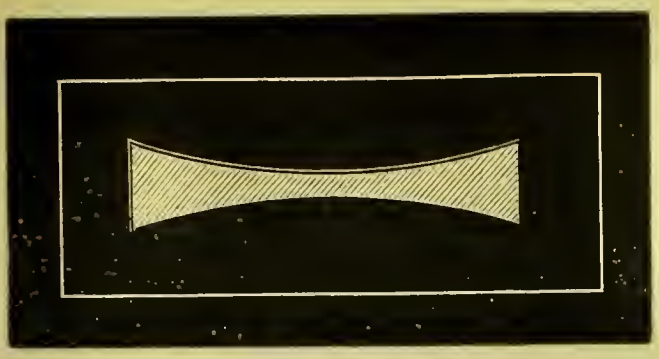


FIG. 17.

and the periscopic, or meniscus, FIG. 18.

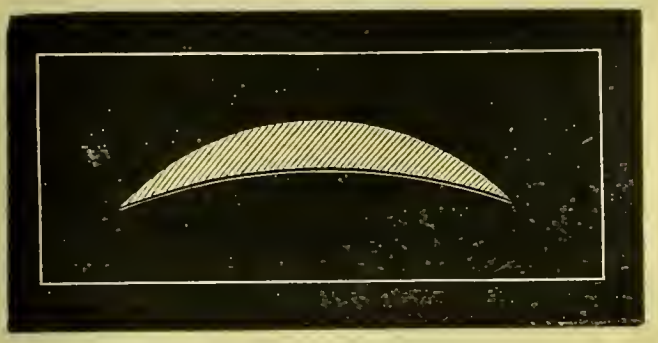


FIG. 18.

It is to Wollaston that we are indebted for the latter form of lens, and for a publication of its advantages.

By FIG. 18, it will be seen that this form of lens is convex on one side, and concave on the other, but with a preponderance of convexity. The peculiar shape of these lenses admits of a more accurate focus of the side rays being obtained, without strain or fatigue to the wearer, and they are now employed by all first-class opticians, and would be even by the second-rate, if the increased cost did not interfere with their rate of gain ; for it cannot be denied, that there are some who, in order to add a few pence to their profit on each pair of spectacles sold, will still supply the old convex form, and the public, who are foolish enough to patronize cheap spectacle traders, suffer as a natural consequence.

How the Required Focal Length of Spectacles

is Determined.—Let us, for a moment, as invisible spectators, suppose ourselves present in the shop of an ordinary optician. A customer enters, requiring a pair of spectacles, and the shopman, having ascertained the quality required, proceeds to lay, say a dozen pairs, on his counter, from which the customer is expected to select a suitable pair.

By chance he may do so, but it is even a greater chance that he may select a pair that, although apparently suiting him for the moment, may be so far from the requisite power as to render their after use painful and detrimental.

It becomes, then, a question of very grave importance for us to consider, how we can aid in the selection, if a customer cannot with certainty select for himself.

It is well known to the mathematician, if we can by any means ascertain the most distinct point of vision of a patient, that by employing certain mathematical calculations, we can ascertain the focus of lenses necessary to employ in order to see at any other required distance; hence the primary aim of the optician should be, to determine this point with all possible accuracy.

The first attempt at anything like scientific adaptation of spectacles was obtained by using the following rule:—If the distance at which a person can read distinctly is multiplied by that at which he wishes to read, and the product divided by the difference of these two distances, the quotient will be the focus in inches of the spectacles required. Thus, supposing a person can read most distinctly when the book is held 24 inches from the eye, and that he desires to read at 12 inches, we get—

$$\frac{24 \times 12}{24 - 12} = \frac{288}{12} = 24$$

hence 24 inches is the focus of the spectacles that should in this case be used.

This plan answers moderately well in those cases where the point of distinct vision is not more distant than 20 or 30 inches, but when long-sightedness has fully developed itself, and the nearest point of distinct vision becomes more distant, the difficulty of estimating the reading distance is so great, that the results obtained are not to be depended on; moreover, by this plan we take no heed of the eye's adjustment, of which more hereafter.

Of course, at the first change from normal to long sight, and in some cases of short sight, it is quite possible to find the most distinct point of vision with all the accuracy we can desire; but when we have to treat a case of short and weak sight combined, or of long sight of advanced age, it is an impossibility to gain the requisite information; moreover, in advanced long sight, this point of vision has so far receded, as to be past the usual range of measurements. In such cases, the employment of a convex lens of suitable focus enables us to so far diminish these, often distant ranges of vision, to measureable distances; and a knowledge of this fact has given rise to all the various forms of optometers now in use.

Unfortunately for the advancement of our knowledge of the focal condition of the eye we examine, the inventors of these most useful instruments have failed to remedy a serious objection to the optometer indications, arising from persons finding it extremely difficult to ascertain the most distinct point of vision, many being enabled to read with equal distinctness over three or four inches of the scale.

My plan is not to ascertain by observation the most *distinct* point of vision on the optometer, but to find

the *nearest* and *farthest* point at which moderately small print is legible, and from these observations the most distinct point can be determined with accuracy by using the formulæ (1), or with still greater ease by the aid of optometer tables, calculated for that purpose. If we could at all times depend on the accuracy of the indications as given by the patient, the adaptation of spectacles by the optometer and its tables would be a very easy matter ; but unfortunately, nervous, weak-sighted, and uneducated patients will often give such indications as to raise a smile, from the utter impossibility of their truthfulness. Often has a nervous and debilitated applicant for optical aid expressed an earnest desire to have the sight carefully tested, and to be supplied with suitable spectacles, and yet has given such erroneous indications as would entirely mislead, if long practice had not raised a suspicion as to their correctness. Such parties, from sheer nervousness, when once they have read the small type presented, will declare they can read it when removed to distances that render it practically impossible ; but if a change of type is made, the fallacious reading is at once detected. To obviate these inconveniences, I have devised a new form of optometer, as shewn at FIG. 19, which is arranged so that each observation can be so

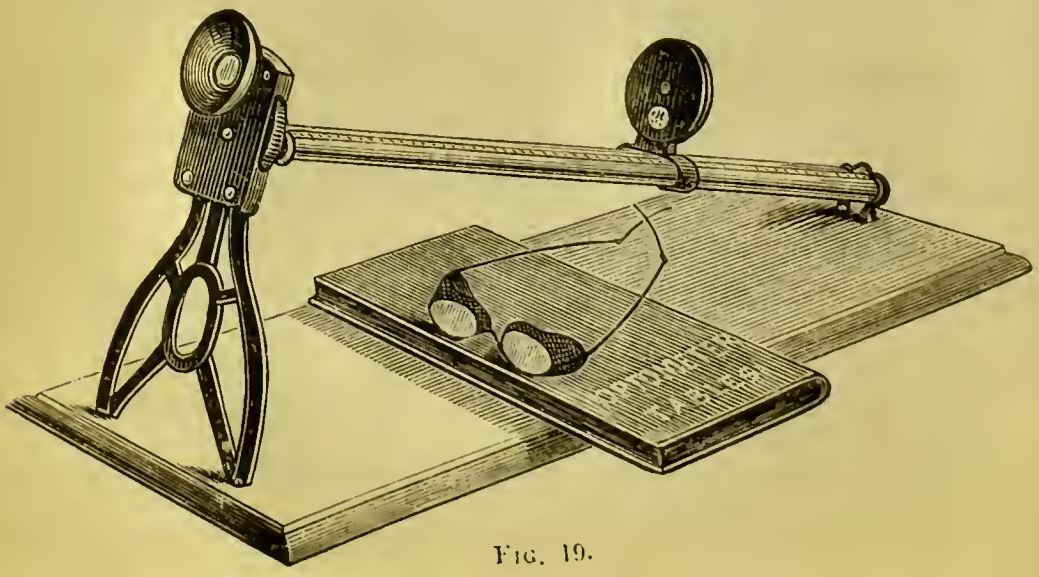


FIG. 19.

thoroughly checked, both by a change of lenses and also of reading type, that it is next to impossible for any erroneous reading to pass undetected, and at the same time no extra calculations are involved, and but one set of tables is needed for the various lenses and scales.

This instrument is an improvement on the form, now so well known as the invention of Dr. Smee, and is of immense value to the scientific optician, enabling him at once to detect any abnormal condition of the eyes, and if different foci, the focus of each—the amount of adjustment, the distinctness of vision, the presence and relative differences of the different meridians in Astigmatism; and its tables point out the lenses needful in each and every case.

Another advantage of using the optometer in selecting spectacles, is, that by its aid we are enabled not only accurately to measure the eye's adjustment for near and far objects, but also to so select our lenses, as to leave *any required portion* of this adjustment to be called into action when using the spectacles so supplied, and this is of immense importance to a weak and debilitated vision.

As there may be cases where the old form of optometer is at hand, but not the improved form with its tables, I herewith subjoin the following:—

Formulæ relating to Spectacles and Vision.

Let n=nearest distance of most distinct vision on optometer

d=farther distance of most distinct vision on optometer

o = focus of optometer lens

R = required distance of distinct vision.

Required to find v = most distinct point of vision on optometer

$$\frac{1}{v} = \frac{1}{2}\left(\frac{1}{n} + \frac{1}{d}\right) \quad (1)$$

N = nearest point of distinct vision

$$\frac{1}{N} = \frac{1}{n} - \frac{1}{o} \quad (2)$$

D = farthest point of distinct vision

$$\frac{1}{D} = \frac{1}{d} - \frac{1}{o} \quad (3)$$

V = most distinct point of vision

$$\frac{1}{V} = \frac{1}{2}\left(\frac{1}{N} + \frac{1}{D}\right) \quad (4)$$

A = eye's adjustment

$$A = \frac{1}{n} - \frac{1}{d} \quad (5)$$

F = focus of spectacle lens

$$\frac{1}{F} = \frac{1}{R} - \frac{1}{V} \text{ or} \quad (6)$$

$$\frac{1}{F} = \frac{1}{R} - \frac{1}{2}\left(\frac{1}{n} + \frac{1}{d}\right) + \frac{1}{o} \quad (7)$$

$$= \frac{1}{R} + \frac{1}{o} - \frac{1}{2}\left(\frac{1}{n} + \frac{1}{d}\right)$$

NS = nearest distinct vision when wearing spectacles

$$\frac{1}{NS} = \frac{1}{F} + \frac{1}{n} - \frac{1}{o} \quad (8)$$

DS = farthest distinct vision when wearing spectacles

$$\frac{1}{DS} = \frac{1}{F} + \frac{1}{d} - \frac{1}{o} \quad (9)$$

Both $\frac{1}{NS}$ and $\frac{1}{DS} = \frac{1}{R} \pm \frac{1}{2}\left(\frac{1}{n} - \frac{1}{d}\right)$

Whenever d is greater than o, to enable distant objects to be seen distinctly, convex lenses are required, the foci of which can be found from

$$\frac{1}{F} = \frac{1}{o} - \frac{1}{d} \qquad (10)$$

But if d is less than o, distant objects can only be seen distinctly by using concave spectacles, the focus of which can be found by

$$\frac{1}{F} = \frac{1}{d} - \frac{1}{o} \qquad (12)$$

To illustrate the utility of these formulæ, we will take the case of a person whose nearest point of most distinct vision on the optometer is 6 inches and his farthest 9 inches, the focus of the optometer lens being 10 inches.

By formula (1) we find his most distinct point of vision on the optometer is 7·199 inches. By formula (2), that his nearest point of distinct vision is 15·0 inches, and by formula (3) that his farthest is 90· inches, whilst formula (4) proves that he can see most distinctly at 25·7 inches. Formula (5) shews the eye's adjustment to be only ·0556, whereas in the healthy eye it is usually ·125. From formula (7) we find that with a pair of spectacles of 22½ inches focus, the person will be enabled to read without any strain on his eyes at 12 inches, and by formula (8 and 9) we find he will be enabled to see distinctly with such spectacles all objects that are situate at from 9 inches to 18 inches from the eye; and lastly, by formula (12) we find distinct vision of distant objects can only be obtained by using concave spectacles of 90 inches focus, so that this person is in reality long-sighted for near objects, and short-sighted for distance.

Snellen's Types.—Another useful adjunct to the optician's accessories for testing the sight, is Snellen's types. These consist of a series of various sized letters of definite height and width, with a distinctive number affixed to each, and so arranged that when at the number of feet from the eye corresponding to the number of the type, the diameter of the letter subtends an angle of one minute, and the height five minutes, and it is assumed that the healthy eye can see any object placed so as to subtend such an angle, and any deviation from the normal distance is easily ascertained : thus the following letters should each be easily named when the book is placed at 12 feet distance from the observer.

F S T C H U E D

SHORT RULES FOR THE PRESERVATION OF SIGHT AND THE SELECTION OF SPECTACLES.

It is of the highest importance that near and distant objects should be equally examined, so that the eye may preserve its fullest power of adjustment. This should be done by the unaided eye alone, where it is possible, but the short-sighted should always use spectacles, as the power to see at different distances becomes paralysed, and different spectacles for near and distant objects will be required.

If the eye becomes inflamed from excessive use, give it perfect rest, and use an eye water composed of sulphate of zinc 3 grains, rosewater 2ozs.

Irritation and inflammation of the eyelids may be removed by their being smeared nightly with a camel's hair brush, charged with an ointment made of red oxide of mercury 3 grains, spermaceti ointment 1 ounce.

Spectacles should only be worn to compensate for any deficiency or excess of refractive power of the eye, and this deficiency or excess should be most carefully ascertained by the use of the optometer, in order to guide us as to the requisite focus needed.

The spectacle frames should be adapted to suit the face, and the centres of the lenses should be nearly the same distance apart as the width between the pupils. It must be especially borne in mind that spectacle lenses should be kept free of scratches, as the existence of any impediment to the free transmission of light interferes with vision, and irritates the eyes.

Use the softest washleather to wipe your spectacles, and if the lenses become scratched, have them exchanged at once.

In no case should spectacles be selected so as to leave the eyes' adjustment nothing to do, but how much may be left for this power of the eye to accomplish, must be determined by the skilled optician, and varies in different cases.

The long-sighted should not view distant objects through spectacles intended for viewing those near at hand, or an immense injury would be done to the eye.

The short-sighted ought always to use spectacles, in order to enable them to view distant objects; but whether they should use spectacles to see near objects, is a question for the optician to decide in each case, on testing the eye; and no general rule can be laid down. In some cases it is beneficial, and in others, decidedly injurious.

Single eye-glasses are injurious, as all the work has to be done with one eye, and their prolonged use is always followed by the focal length of the eyes differing from each other.

The eye should never view an intense light.

In using artificial light, never allow any of its rays to fall on the eye, but so shade it that the light may fall freely on the book or object viewed.

Never use a flickering or unsteady light for reading or writing, and avoid being employed on black objects by artificial light, as daylight alone furnishes sufficient light for this purpose.

Those afflicted with weak sight should avoid the use of gas as much as possible, and read, write, or sew, by the

more steady and soothing light of a properly constructed reading lamp.

Never read during railway travelling, as the rotatory motion causes a strain on the eye.

Glasses of a neutral tint should be used to protect the eyes from sunlight, when weak or inflamed.

OPINIONS OF THE PRESS.

HINTS ON SPECTACLES. By W. ACKLAND, Surgeon. London: Horne and Thornthwaite.

THIS pamphlet shows what is required to be considered in choosing a pair of spectacles. It has no pretensions to give any fresh information as regards optics or the physiology of the eyes, but will be very useful to those who, finding their eyesight failing somewhat, may wish to know the consequences attendant upon the use of glasses unfitted for them. Mr. ACKLAND has done his work in a very satisfactory manner, and we hope that other opticians also will publish pamphlets, as Messrs. Horne and Thornthwaite have done in this case, to save trouble both to their customers and to themselves.

The matter of the pamphlet is very ably written, and is eminently practical. * * * * * * The diagrams illustrating the different kinds of sight are excellent. The symptoms indicating a necessity for spectacles are so clearly laid down that not even a hypochondriac could mistake them. * * * * * * A great practical point, as shown here, is to examine the lenses by polarised light, to see if they be properly cut from the crystal. The principles of Smee's optometer and Snellen's types are made very clear. The short rules which are given for the preservation of sight and selection of spectacles should be read by everybody, especially persons who are obliged to use their eyes much owing to literary occupations. * * * * * * The good reasons for these hints are obvious, but it is as well to repeat them, as there is a great deal of difference between recollecting and remembering a fact. As will be judged from the above extracts, the pamphlet is eminently practical, and we think that few could read it without being convinced that they had learnt something fresh.—*The Chemical News.*

HINTS ON SPECTACLES. By W. ACKLAND, Surgeon. London: Horne and Thornthwaite.

WE have often presented Mr. ACKLAND to our readers as a Mathematical Instrument Maker, and a Photographer, accomplished and skilful. He comes now before us as an Author—not, it is true, in the present instance, of a Work on Photography, but of an important branch of Optics, in which all are more or less interested—the Preservation of Sight by Optical Means.

Opening with a Physiological description of that delicate organ the Eye, Mr. ACKLAND, who, we may premise, is a duly qualified Medical man, treats of the Theory of Vision, the Adjustment of the Eye, and on the Defects known as Long and Short Sight.—*The British Journal of Photography.*

HINTS ON SPECTACLES. By W. ACKLAND, Surgeon. London: Horne and Thornthwaite, Newgate Street, E.C.

THIS little work, although a trade pamphlet of the usual character, is unusually good, by virtue of the original and special information it contains.—*The English Mechanic.*

HINTS ON SPECTACLES: When to Wear and How to Select Them. By W. ACKLAND, Surgeon. London: Horne and Thornthwaite.

THE name of Mr. ACKLAND is well and favourably known to Photographers, in especial connection with their own art. In the little pamphlet before us they will find him an equally trustworthy guide on a subject of the deepest importance to all who value their eyesight. We have an exceedingly clear and simple exposition of the whole subject, and especially of what the skilled oculist can do to remedy the various forms of imperfect vision. We commend the little pamphlet very heartily to all interested in its subject.—*The Photographic News.*

HINTS ON SPECTACLES. By W. ACKLAND, Surgeon. London: Horne and Thornthwaite, 122 and 123, Newgate Street.

THE hints given in the thirty-two pages which form this pamphlet, should be attentively perused by all, who, from natural decay of the sight, or suffering from impaired vision from any of the numerous causes, contemplate resorting to the aid of spectacles. They give the uninitiated a good insight into the Structure of the Eye, the Theory of Vision, and the Causes and Effects of Long and Short-sightedness. They, moreover, explain the basis on which Optical study is founded; point out the advantage of Spectacles and other Optical adjuncts to Vision, showing how cheap, ill-fitting glasses injure rather than improve the Vision, and how the required focal length of Spectacles is determined. To render the scientific portions of the explanations more explicit, Mr. ACKLAND illustrates his work with several well-executed engravings; and attached to the "argument," he has supplied a few short rules for the Preservation of Sight and the selection of Spectacles. Mr. ACKLAND has evidently a thorough knowledge of the science which he undertakes to explain, for, having the advantage of being a duly qualified Medical Practitioner, he has practised as an Optician and Oculist for the last fourteen years, making the adaptation of Spectacles his especial study, and having daily experience in the Establishment of Messrs. Horne and Thornthwaite, who are Opticians to the Queen. He enters at considerable length on the means adopted for ascertaining the requisite focal length of Spectacles, alluding to the principle of Smee's Optometer, pointing out its advantages and defects, explaining in detail an Optometer of his own invention, based on the same principles as Dr. Smee's, by which the whole of the objections of the former are entirely removed. In this short notice it would be utterly impossible to convey to the reader an idea of the amount of Scientific knowledge which Mr. ACKLAND has thrown into this *brochure*, therefore we must content ourselves by stating that by the aid of mathematical problems he has rendered his descriptions so thoroughly explicit as to bring them within the understanding of everyone. But apart from the scientific importance of the little work, it has a general interest to all gifted with the blessing of vision.—*Brighton Observer.*

Printed by W. H. COX, 5, Great Queen Street.